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OAI

OPERATION MANUAL

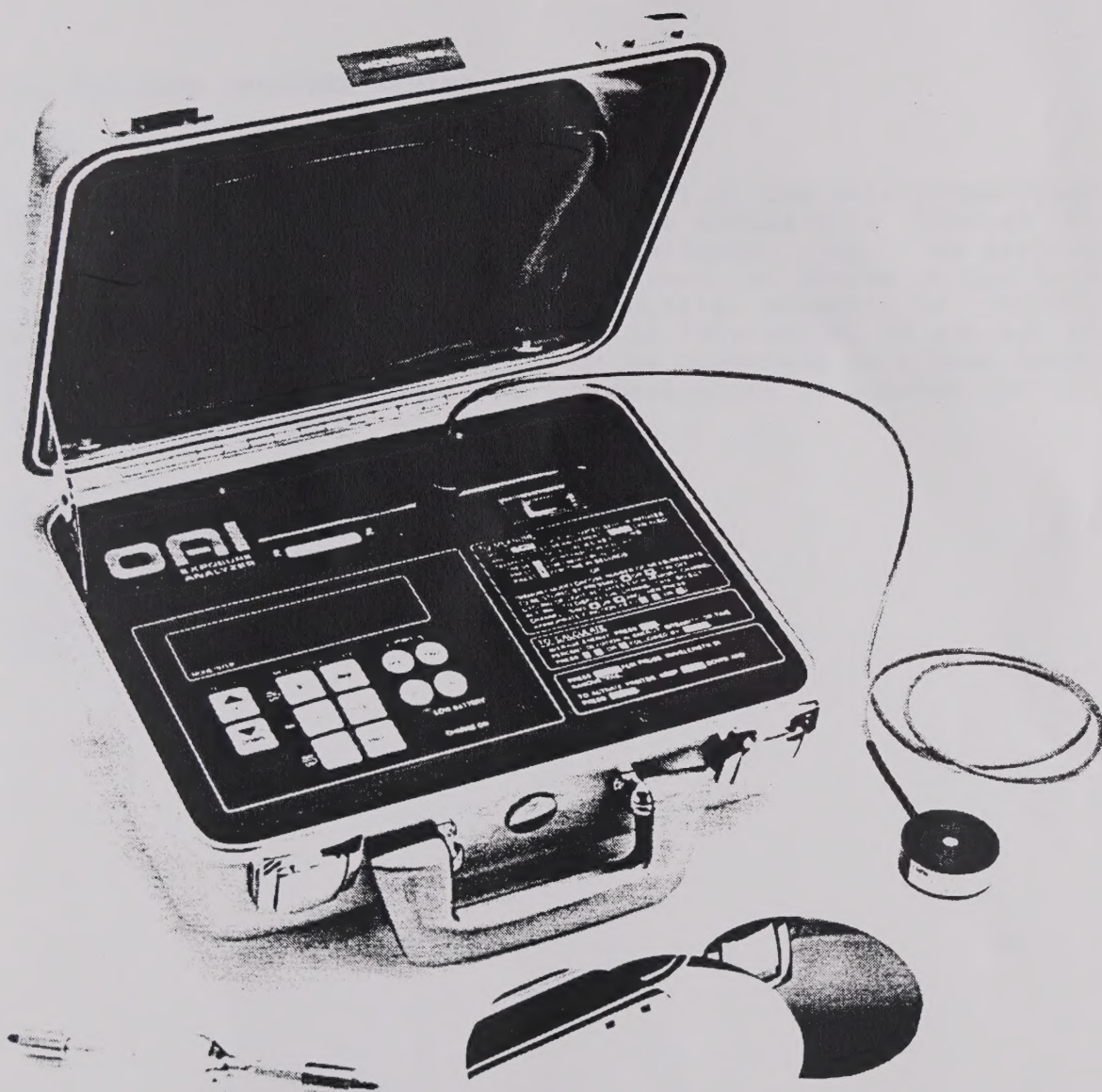
MODEL 356 EXPOSURE ANALYZER

OAI Optical Associates Inc.

Leader in Generation, Measurement, and Control of UV Energy

CAUTION: Before beginning operation of your Exposure Analyzer, insure that the line voltage setting in the analyzer is equivalent to your house line voltage. See Section IV for detailed instructions to verify and/or reset the line voltage in your analyzer.

Although each instrument in the OAI Exposure Analyzer Series utilizes a similar operating system, each meter has been designed for use with a specific type of alignment equipment. Optical probes are not interchangeable between the Model 356, 357, and 358. Each model employs different operating parameters, i.e., exposure intensity levels, initial meter response threshold, lower level linearity, and upper limit response. OAI will not assure the reliability of the data obtained if an exposure analyzer or probe is incorrectly used with other than the equipment specified.



Model 356 Exposure Analyzer



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OAI EXPOSURE ANALYZER SERIES

MODEL 356

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OAI EXPOSURE ANALYZER

MODEL 356

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SECTION I

INTRODUCTION

CERTIFICATION

OAI certifies that each OAI MODEL 356 EXPOSURE ANALYZER met or exceeded its technical specifications when it left the factory. It was calibrated in simulation testing against measurement standards, and all control and measurement functions worked properly.

WARRANTY AND ASSISTANCE

This product is warranted against defects in materials and workmanship for a period of six months from the date of shipment. OAI will, at its option, repair or replace without charge products that prove defective within the limits expressed herein. Equipment that has been abused, misused, or operated on an incorrect power source, or on which the factory seals have been broken, is excluded from warranty coverage. No other warranty is expressed or implied, and no agent or representative has the power to alter or to extend OAI's liability as stated herein. Determination of the suitability of the product or its fitness to a particular purpose lies solely with the buyer. OAI assumes no liability for any incidental or consequential damages or expenses. In addition to the remedies herein provided, the buyer may have other rights, which vary from state to state.

RETURN POLICY

Notify OAI before returning any product to the factory so that the shipment can be expected, thereby avoiding possible losses or misunderstandings. OAI MUST ISSUE A RETURN AUTHORIZATION NUMBER AND MUST OBTAIN A PURCHASE ORDER NUMBER PRIOR TO THE RETURN OF ANY EQUIPMENT TO THE FACTORY. A written description of the symptoms to be corrected and advisement of the action desired should accompany the product being returned. No credits, allowances, or replacements will be made until alleged defects are established to the satisfaction of OAI. Time spent by OAI in checking equipment that is found to have no defects may be chargeable, warranty status notwithstanding. Products returned to OAI for warranty service must be shipped with transportation costs prepaid by the buyer. OAI will prepay the shipment back to the buyer after warranty service via surface. OAI reserves the right to refuse collect shipments, or to impose a service charge, in addition to C.O.D. costs, if electing to handle a collect shipment. Nonwarranty repairs and calibration services are available at prevailing OAI rates; the buyer pays the transportation cost both ways.

UNPACKING AND INSPECTION

If the shipping carton shows evidence of damage, ask that the carrier's agent be present when the instrument is unpacked. Look for obvious damage, like scratches and dents. If the equipment has been damaged in transit, save the shipping and packing materials for the carrier's inspection, and contact OAI immediately. OAI will replace products suffering from verifiable shipping damage without waiting for the carrier's insurance settlement (subject to product availability).

SECTION II

SYSTEM DESCRIPTION

OVERVIEW

The OAI Model 356 Exposure Analyzer is a microprocessor based monitor that allows storage and recall of multiple exposure parameters (intensity, energy, and time) collected from the exposure series. The monitor also calculates the percent deviation of intensity, energy, and time for a series of up to nine separate exposures, as well as calculating the average energy. AC or battery operated; the system features automatic shut-off.

SYSTEM COMPONENTS

The OAI Model 356 Exposure Analyzer consists of two components: An optical probe and an electronics package.

MODEL 356 EXPOSURE ANALYZER FOR USE WITH CONTACT/PROXIMITY ALIGNERS, THE OAI HYBRALIGN MASK ALIGNMENT AND EXPOSURE SYSTEM SERIES AND OTHER EXPOSURE SYSTEMS

The Model 356 Exposure Analyzer is designed to be a simple tool for checking the key parameters of near and deep ultraviolet exposure. Up to nine exposures can be checked in rapid succession without resetting the analyzer. Reads intensity, energy, and time collected from the exposure series (400 mW/cm², 9999 mJ/cm², 9999 seconds). Calculates percent deviation and averages energy. Available with choice of probe spectral responses: Deep Ultraviolet 220 or 260nm and Near Ultraviolet 310, 365, 380, 400, 420, 436, or 540nm.

OPTICAL PROBES

The wavelength of probe to be used with the system depends upon the aligner to be monitored. Regardless of which probe is used, the connection to the meter itself remains the same: A keyed connection which ensures that the probe cannot be connected incorrectly. A protective pouch is provided for storing the probe (or probes) when not in use.

In the probe head, a silicon sensor and absorption glass filter provides a shaped spectral response corresponding to any common photoresist, as shown on OAI standard response curves. The sensor's spectral response should be selected to achieve the best fit with the response curve of the photoresist to be used (see Specifications).

PRECISION PROBE ASSEMBLIES SHOULD NOT BE SUBJECTED TO IMPROPER HANDLING (I.E., SHOCK). PROBE SHOULD BE UNPLUGGED FROM METER ASSEMBLY BY GRASPING THE CONNECTOR FIRMLY. DO NOT ATTEMPT TO PULL, STRETCH OR SUSPEND THE PROBE BODY BY ITS CORD AT ANY TIME. TO AVOID INTERNAL DAMAGE, PROBE BODY MUST BE SUPPORTED DURING ANY TYPE OF MOVEMENT.

NOTE: PROBES ARE NOT INTERCHANGEABLE FROM ONE MODEL TO ANOTHER

ELECTRONICS PACKAGE

The controls, displays, and electronics circuitry of the OAI Model 356 are packaged in a rugged portable case. Power is supplied by a 6-volt rechargeable battery or by AC. Under battery operation, the unit will automatically shut off if not used within six minutes. After five minutes, the display will flash, warning the operator of auto-shutoff in one minute. Under AC operation, the battery is recharging and the auto-off is disabled.

TABLE 1

MODEL 356 DISPLAY AND KEY FUNCTIONS

Energy	Selects energy mode. Displays "E" in function display, mJ/cm ² in data display.
Intensity	Selects intensity mode. Displays "I" in function display, mW/cm ² in data display.
Time	Selects time mode. Displays "S" for seconds in function display, seconds elapsed in data display.
Average	Displays average energy in mJ/cm ² among multiple readings in data display. Displays "A" in mode/step display and "E" in function display. Displays zeroes in continuous mode.
Percent Deviation	Displays percent deviation multiple readings of energy, intensity, or time in data display. Displays "P" in mode/step display. The desired parameter must be selected first. For example, press "E," then "% DEV" for percent deviation of energy readout. Displays zeroes in continuous mode.
Probe	Displays probe wavelength response in nanometers in data display.
Start	Enables data collection circuitry. Measurement begins when light strikes the probe.
Hold	Stops the measurement process and freezes display readings.
Up	Used to enter the desired number of readings to be taken (up to nine), or to step through the readings taken in ascending order.
Down	Same function as Up, but steps through the readings in descending order.

FUNCTION DISPLAY CHARACTERS

E Energy
I Intensity

S Time (Seconds)

MODE/STEP DISPLAY CHARACTERS

0-9	Number of readings to be taken.
C	Continuous mode; measurement begins when light strikes probe.
G	Memory mode. Ready to <u>G</u> o; first reading starts when light strikes probe.
F	Measurement sequence <u>F</u> inished (memory mode only).
A	Indicates that the value in the data display is <u>A</u> verage energy.
P	Indicates that the value in the data display is <u>P</u> ercent Deviation of energy, intensity, or time, depending on which character is in the function display (E, I, or S).
DATA DISPLAY	Displays numeric values or P--- for probe wavelength.

SECTION III

MEASUREMENT PARAMETERS

INTENSITY (mW/cm²)

Intensity is defined as the illumination power per unit of area at a given point in time. The OAI Exposure Analyzer measures intensity in milliWatts per square centimeter (mW/cm²).

ENERGY (mJ/cm²)

Energy is the measure of light intensity over time. If light intensity is constant, energy is equal to the product of time and intensity. In the more general case, when intensity varies, energy is the integral of intensity over time. The OAI Exposure Analyzer performs this integration and displays the energy values in milliJoules per square centimeter (mJ/cm²).

AVERAGE ENERGY (Memory Mode Only)

The average energy for two or more exposures (up to nine) can be computed and displayed simply by pressing the AVG button.

$$\text{Average (En)} = \frac{E1 + E2 + . . . En}{n}$$

where n = number of exposures

PERCENT DEVIATION (Memory Mode Only)

The percent deviation of energy, intensity, or time for two or more exposures can be computed and displayed by pressing the desired parameter, followed by the % DEV button.

$$\text{Percent Deviation} = \frac{(X_{\text{max}} - X_{\text{min}}) \times 100}{X_{\text{max}} + X_{\text{min}}}$$

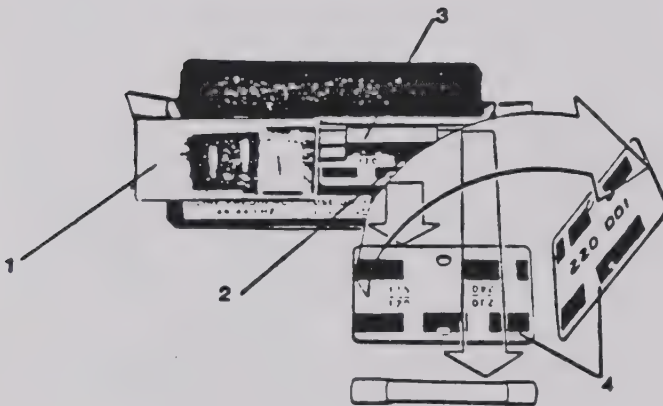
where X_{max} = parameter maximum value

X_{min} = parameter minimum value

SECTION IV
OPERATING PROCEDURE

CAUTION: BEFORE BEGINNING OPERATION OF THE OAI EXPOSURE ANALYZER INSURE THAT THE LINE VOLTAGE SETTING IN YOUR ANALYZER IS EQUIVALENT TO YOUR LINE VOLTAGE (I.E., 110V, 220V, ETC.).

DIAGRAM 1: LINE CORD POWER MODULE



1. Draw fuse extractor to left and remove fuse.
2. Remove PC selector board and rotate until desired voltage is shown on left side.
3. Reinsert selector board firmly into module slot.
4. Return Fuse extractor to normal position, and insert appropriate fuse.
5. Slide window to right and insert line cord.

The following steps must be taken to verify and/or reset the line voltage:

1. Slide the transparent window (1) on the line cord power module to the far left.
2. Lift the fuse extractor (2) and remove the fuse (3).
3. Remove the PC Selector Board (4) using needle nose or any type small nosed pliers.
4. Rotate the PC Selector Board (4) until desired voltage is shown on the left side (i.e., 110, 120, 220 or 240).
5. Reinsert the PC Selector Board (4) firmly into the module slot. Make sure the board clicks into place.
6. Return the fuse extractor (2) to normal position and reinsert appropriate fuse.
7. Slide transparent window (1) to the far right and insert line cord.

MODES OF OPERATION

- o CONTINUOUS MODE: The monitor measures continuously until the shutter closes or the operator presses HOLD.
- o MEMORY MODE: Used to collect from one to nine readings of energy, intensity, and time, and store them in memory for later recall or printout. Average energy and percent deviation of energy, intensity, and time can be computed and displayed in this mode.

CONTINUOUS MODE

After power has been turned on, make sure that a zero appears in the mode/step display. If it does not, press the UP or DOWN button, as required, until the display reads zero. Then press the START button. A "C" will appear in the mode/step display, signifying that it is in the continuous mode. Place the probe in the light path and open the lightsource shutter. When the intensity threshold is met, the Exposure Analyzer will automatically begin measuring.

At any time during the measurement, the operator may view any of the parameters (including probe wavelength) by simply pressing the appropriate button.

The monitoring process can be halted at any time before the shutter closes by pressing HOLD. Once this is done, the operator can go back and read the accumulated values for time and energy, and the intensity level last seen by the probe. To start measuring again, simply press START. Once the START button is pressed, all previous values will be reset to zero and the monitor will begin measuring (assuming the shutter is open).

INSTRUCTIONS FOR USING THE OPTIONAL THERMAL PRINTER SEE SECTION V.

MEMORY MODE

Press the UP or the DOWN button until the desired number of readings to be taken appears in the mode/step display. Press the START button and a "G" appears in the mode/step display, signifying that the system is ready to go. Place the probe in the light path and open the lightsource shutter. When the intensity threshold is met, the "G" in the mode/step display changes to a "1," indicating that the first reading is being taken. When the shutter closes, the mode/step display automatically increments to "2". This sequence continues until the shutter closes for the last exposure. At that time an "F"

appears in the mode/step display, signifying that the sequence of readings is finished.

To review the parameters for any or all of the exposures, step the unit through to the desired memory location(s) using the UP or DOWN button. Once the number corresponding to the requested exposure appears in the mode/step display, the parameter values can be displayed by pressing the appropriate keys.

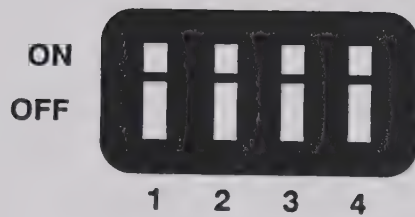
A percent deviation of intensity, energy, or time can be displayed by pressing the parameter key for the percent deviation to be calculated, followed by the % DEV key. Average energy can be calculated and displayed by pressing the AVG button.

Once again, the data gathered can be sent to a printer for hardcopy by holding down the HOLD button and pressing START.

To start the sequence of readings again, press START. This will reset the memory locations to zero and set the mode/step display to "G"--ready to go.

To switch to the continuous mode, set the mode/step display to "0" and press START, thus changing the display to "C" as described for continuous mode of operation.

TABLE 2
DIP SWITCH SETTINGS



Switch	ON	OFF
1	Buzzer On	Buzzer Off
2	RS232 Pin 2=Tx	RS232 Pin 2=Open
3	RS232 Pin 3=Tx	RS232 Pin 3=Open
4	Not Used	Not Used

SECTION V

SPECIFICATIONS

MODEL 356 EXPOSURE ANALYZER

EXPOSURE ANALYZER	CALIBRATION ACCURACY	+/- 3% (traceable to NBS)
	LINEARITY	Within 2% over the full range
	FULL-SCALE RANGES	
	Time	0 to 9999 seconds
	Energy	0 to 9999 mJ/cm ²
	Intensity	4 to 400 mW/cm ²
	ELECTRONICS	Intel 8039 Microprocessor controlled
	DATA OUTPUT	4-digit LED display; RS-232-C 300 baud rate transmit only
	DATE INPUT	Membrane keypad with audible feedback; light-activated measurement
	PROGRAMMED FUNCTIONS	
	Measurements	Intensity, Time, Energy
	Calculations	Average energy; percent deviation in energy, intensity, and time for up to nine channels
	I/O:	Print, channel select, automatic data acquisition, probe wavelength check
	POWER	110/220 VAC, 50/60 Hz Rechargeable 6V battery (with automatic power-off feature)
	DIMENSIONS (cm) (in.)	30.5 wide X 22.9 high X 12.7 deep 12.0 wide X 9.0 high X 5.0 deep
	WEIGHT	3.6 kg (8 lbs), approximately
	OPTIONAL PRINTER	Memodyne MAP-20S

PROBES	RESPONSES	Choice of OAI standard responses
	Deep UV (nm)	220, 260
	Near UV (nm)	310, 365, 380, 400, 420, 436 540
	SENSOR MATERIAL	Silicon, UV-enhanced
	FILTER	Multilayer absorption glass and/or dielectric filter
	PROBE DIMENSIONS	
	(cm)	4.45 diameter X 1.6 thick
	(in.)	1.75 X 0.63
	WEIGHT	.11 kg (4.0 oz), approximately

OAI TRACEABILITY TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST).

For OAI Standard UV Measuring Instrumentation¹

1.1 NIST TRANSFER STANDARDS

Once a year OAI sends their precision volt meter to a local calibration laboratory which has traceable standards to NIST. This traceable voltmeter is used to calibrate our constant current sources which in turn are used to calibrate all the digital UV meters and analyzers.

1.2 PYROELECTRIC RADIOMETER

The NIST traceable primary standard for calibration is the Laser Precision RS-5900 electrically calibrated pyroelectric radiometer (ECPR), which has a $\pm 1\%$ traceability to NIST. The basic ECPR system consists of a RSP-590 electrically calibrated pyroelectric detector, a CTX-515 fixed speed chopper, and a RS-5900 readout.

The RSP-590 probe consists of a Lithium Tantalate pyroelectric detector with a thin-film heater deposited on its surface. The pyroelectric material is sandwiched between the conducting electrodes. The front electrode is a gold black coating which is both highly absorbing and electrically conductive. The pyroelectric material contains an electric dipole moment which is a function of temperature. Thus, when heated, the induced charge on the surface electrodes changes and a current flows to the preamplifier. The heat input may come either from optical radiation absorbed in the "black" or from electrical power dissipated in the "black." The electrical power is used for calibration and is determined using a four wire measurement of the voltage and current at the heater. The detector produces an output only when its temperature is changing. Therefore, the input power must always be chopped.

The RS-5900 contains a tuned (to chopper frequency) lock-in voltmeter serving as a null detector, the electrical drive circuitry, and a microprocessor-based measurement and control system.

¹ Excludes OAI's 380 Series Stepper Probes and Laser Meter. See other Traceability letter.

1.3 SECONDARY PROBE CALIBRATION

OAI uses a series of photo diode based transfer standards. These are calibrated to the Pyroelectric Radiometer as described below.

OAI probes achieve their spectral selectivity through the use of carefully designed optical absorption glass filter stacks. Response curves for these stacks have been measured and are available in your manual.

For calibration, a filter stack is placed in the path of light between the light source and the pyroelectric detector. A precisely measured aperture is placed over the entrance of the pyroelectric detector, and radiation of the appropriate spectral composition is applied. The reading in watts is noted, and converted to mW/cm^2 . Next, a photo diode base probe with the same filter stack as used in the light path is placed in the light field. The OAI probe and meter reading must be the same as the pyroelectric radiometer.

The OAI probe calibration resistance is determined by adjusting the resistance of a decade box in series with the probe. When the desired reading is achieved, a resistor is soldered into the probe circuit and the calibration is rechecked.

The procedure is repeated for all probe standards.

1.4 WORKING PROBE STANDARDS CALIBRATION

A full set of working standards is calibrated by direct comparison with the secondary set of probes.

1.5 PRODUCT CALIBRATION

All OAI probes shipped to customers are calibrated by direct comparison to the appropriate working standard probes. The probes are traceable to NIST with an uncertainty of $\pm 3.0\%$.

1.6 RECALIBRATION SCHEDULE

Primary standards (Voltmeter, and Pyroelectric Radiometer) are recalibrated once a year. Secondary standards are recalibrated once a year. Working standards are recalibrated every month.

